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(54) Mobile telephone with partial retransmission of original frames

(57) A digital mobile telephone control system is provided with the facility for partial retransmission of original Layer 2 frames where Layer 2 is a frame structure for messages. Error recovery allows identification of Layer 1 units of the frames which require retransmission where Layer 1 is the manner in which frames are divided for transmission. Partial rejection frames (REJ', Fig 2) and partial retransmission frames (I', Fig 2) allow control fields in frame headers to occupy one or more header extension units. The final header extension unit is padded to standard unit length. Control field extension bits (EC, Fig 4) are used to identify extension header units and to allow total rejection at Layer 2 level if such a unit is corrupted. Partial retransmission saves time.

FIG. 1

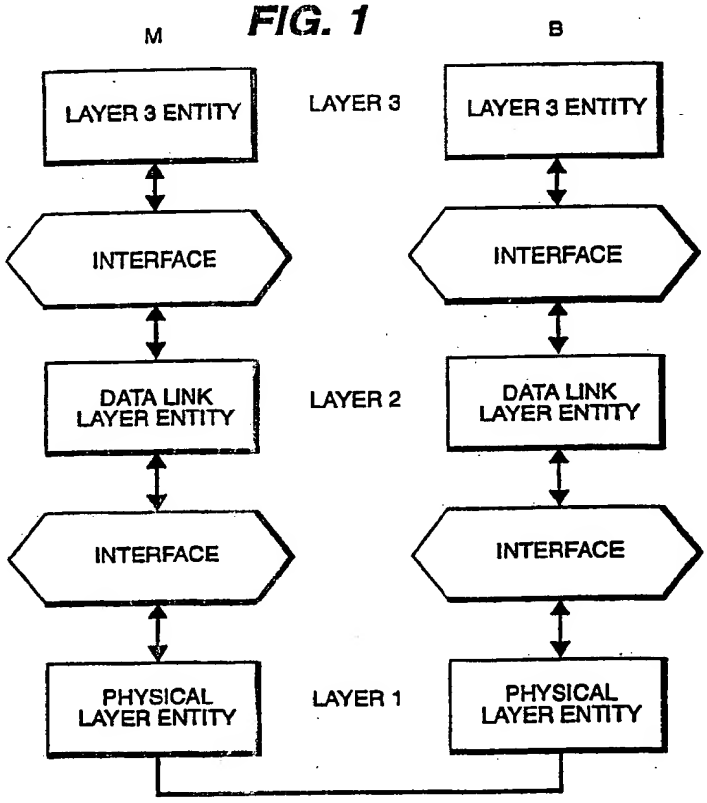

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FIG. 1

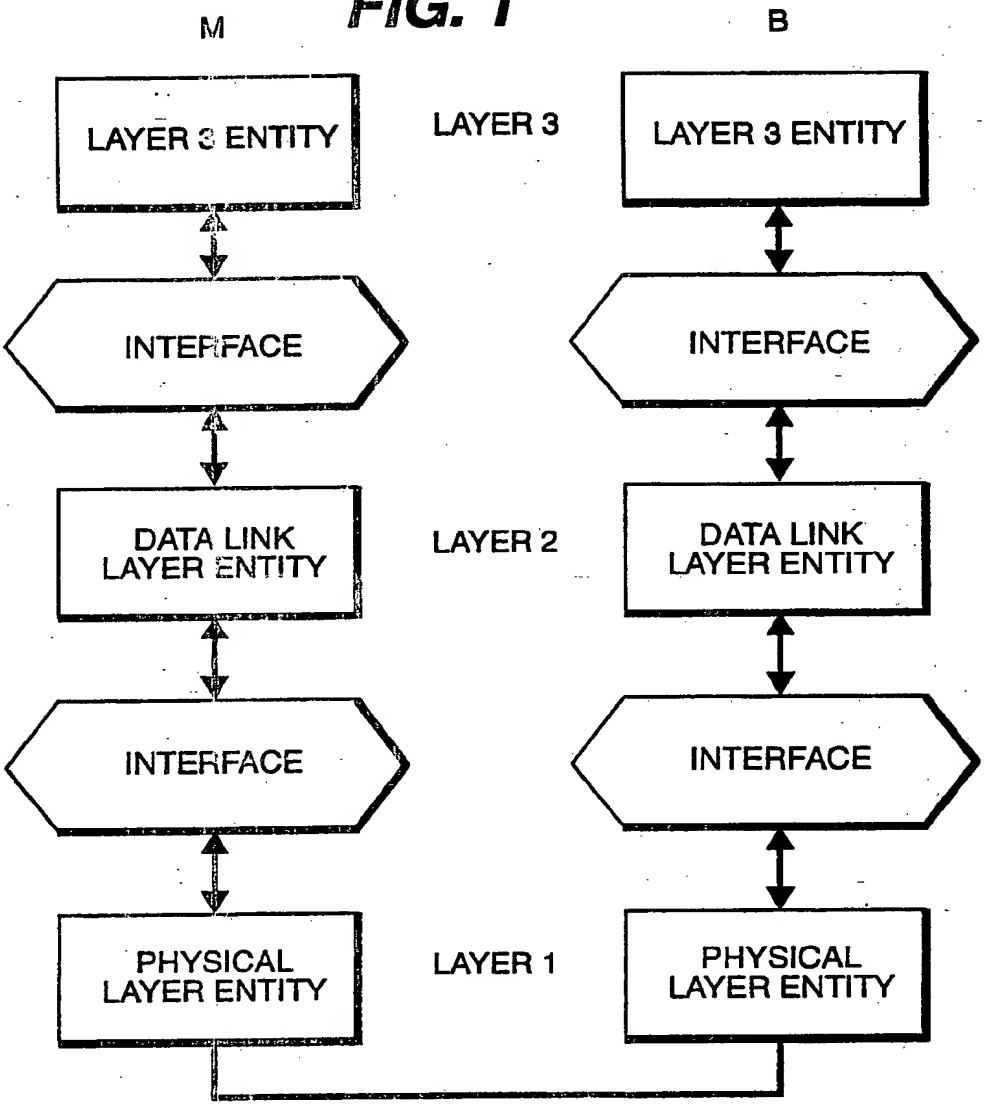


FIG. 4

CONTROL FIELD BIT	8	7	6	5	4	3	2	1
I FORMAT	N(S)						0	0
	N(R)						P	EC
S FORMAT	X	X	X	X	S1	S2	0	1
	N(R)						P/F	EC

FIG. 2

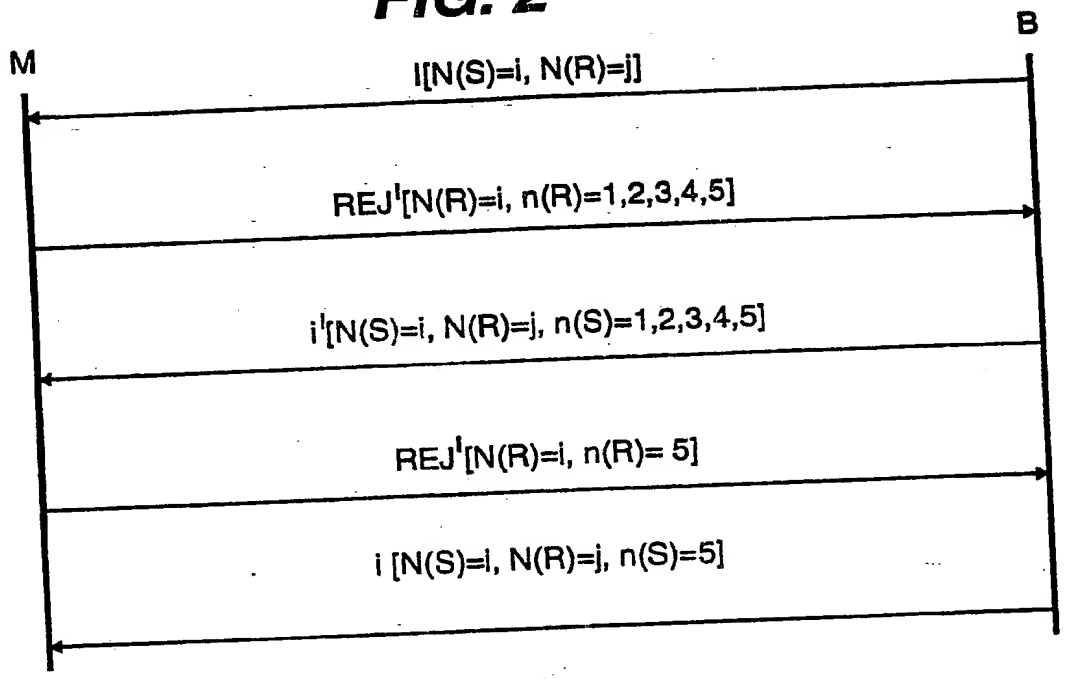
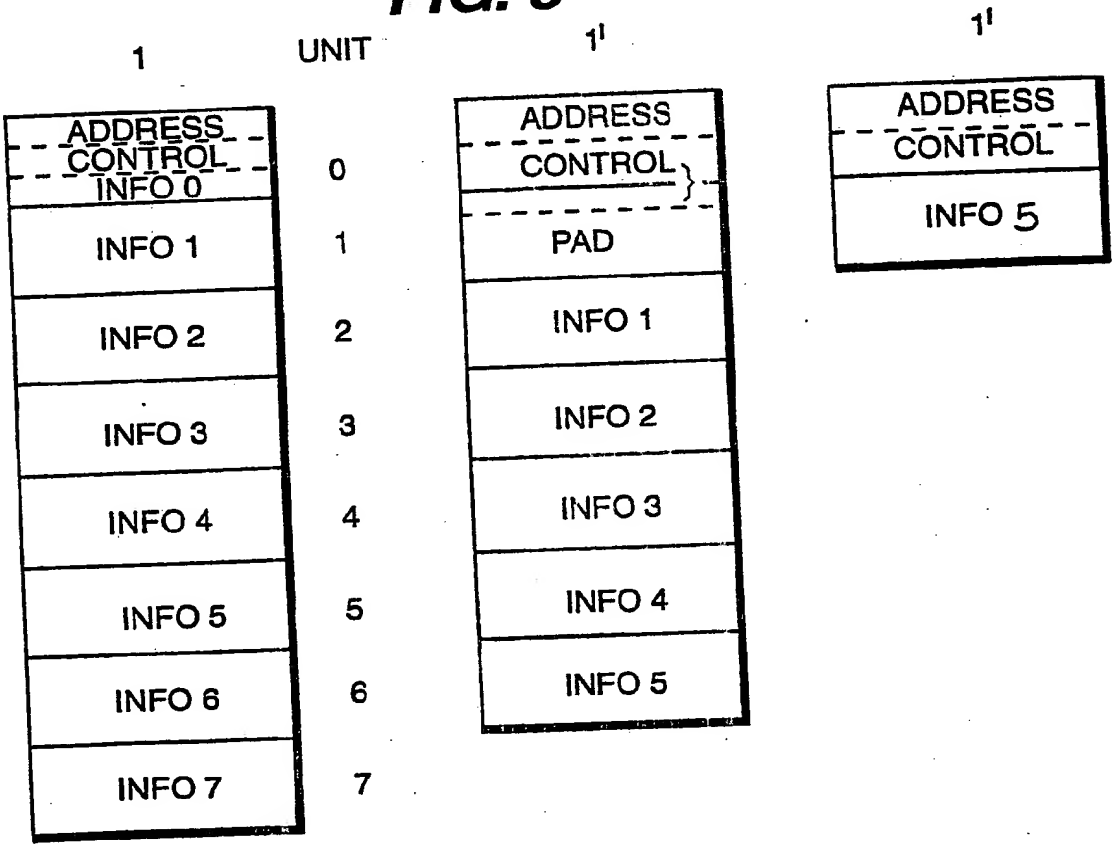

M
B
I[N(S)=i, N(R)=j]
REJ'[N(R)=i, n(R)=1,2,3,4,5]
i'[N(S)=i, N(R)=j, n(S)=1,2,3,4,5]
REJ'[N(R)=i, n(R)= 5]
i [N(S)=i, N(R)=j, n(S)=5]

FIG. 3


1
UNIT
1'
1'
ADDRESS
CONTROL
INFO 0
INFO 1
INFO 2
INFO 3
INFO 4
INFO 5
INFO 6
INFO 7
0
1
2
3
4
5
6
7
ADDRESS
CONTROL
PAD
INFO 1
INFO 2
INFO 3
INFO 4
INFO 5
ADDRESS
CONTROL
INFO 5

DIGITAL MOBILE TELEPHONE CONTROL SYSTEM

The invention relates to a digital mobile telephone control system and in particular to the partial retransmission of messages in such a system.

A mobile telephone system is conventionally conceived as a hierarchy of layers at each of the mobile and base stations. The uppermost layers concern equipment handled directly by the user and the lowermost layers concern protocols in assembling and disassembling messages for transmission between stations. Messages are passed from an upper layer at a transmitting station via successively lower layers to the lowest layer (Layer 1) at that station, thence by radio to Layer 1 at the receiving station and by successively higher layers to the corresponding upper layer at the receiving station. Layer 1 is a time division multiple access (TDMA) layer and Layer 2 is a link access protocol for digital mobile channels (LAPDM) layer. The present invention is concerned with interaction between Layer 1 and Layer 2.

Layer 2 specifies a frame structure for messages and Layer 1 specifies the manner in which frames are divided into units for transmission. It is known to provide an error recovery system which generates a request for retransmission of a frame of information if an error is detected. In some systems a frame can be relatively large and in order to save time in retransmission it is proposed to detect part-frames in which errors occur and to retransmit only the relevant part-frames instead of the whole frame. The first part of a frame comprises an address field and a control field. For normal frames it is possible to predict a maximum length for the address and control

fields. A rejection frame REJ requests the transmission of a complete frame and the length of the address and control fields will correspond to that of a normal frame. In some situations, however, the address field may be longer than normal. Also, particularly in a partial retransmission system it is necessary to specify those parts of a frame which (a) require retransmission in a partial rejection REJ' frame and (b) are retransmitted in a partial retransmission I' frame. The frame parts for retransmission are specified in the control field as a list. The list may take the combination of address and control field length over their normal boundary in Layer 2. This overflow may be due to a combination of list size with an oversize address field. The present invention recognises that this raises problems at Layer 1 and proposes a solution.

According to the invention there is provided a digital mobile telephone control system comprising a LAPDM Layer 2 which interfaces with a TDMA Layer 1 wherein Layer 2 defines a frame structure for information, each frame consisting of a frame header having address/control fields and Layer 1 defines a structure whereby frames are disassembled to a unit structure for transmission and subsequently reassembled, the system including a facility for partial retransmission of original frames whereby some frames are partial rejection REJ' frames and some are partial retransmission I' frames, the control fields of the REJ' and I' frames including lists which identify units of the original frame which are for retransmission, the system being such that the frame headers for REJ' and I' frames may comprise one or more extension units and the or the final extension unit is padded to preserve the predetermined Layer 1

unit length.

Preferably Layer 1 includes a facility for total rejection of a frame when an error is detected in the first header unit and Layer 2 includes a facility for total rejection of a frame when an error is detected in a header extension unit.

Preferably the digital format for a control field includes a control field extension bit EC which is set to designate the final part of the control field and the Layer 2 total rejection facility uses the EC bit setting to recognise header extension units.

The invention will further be described with reference to the accompanying drawings of which:-

Figure 1 is a diagram illustrating the layered structure of a mobile telephone system;

Figure 2 is a diagram illustrating an example of information flow in a system in accordance with the invention;

Figure 3 is a diagram illustrating frame compositions for the example of Figure 2; and

Figure 4 is a diagram illustrating the control field bit pattern for the system.

Referring to Figure 1 there is shown schematically a multi-layer mobile telephone system. A mobile unit M and a base unit B have the same hierarchical layered structure. Layer 3 entities are protocol entities for call control, mobility management and radio frequency transmission management etc. The system is digital, so that if the original signals are analogue as in a telephone, for example,

they are converted to digital form.

Layer 3 interfaces with a Layer 2 which is a LAPDM layer which specifies frames for the information to be sent. Layer 2 interfaces with a Layer 1 which establishes physical (in practice radio) connection between the stations and conducts such communication in a TDMA system in which the frame data is divided into unit sizes. Each unit is a specific number of octets of data bits.

The major purposes of the LAPDM in this example is to provide for the following:

1) Connections between several mobile stations on the user/network interface
2) Multiple layer 3 entities
3) Information transfer by the broadcast channel (BCCH)
4) Information transfer by the paging channel (PCH)
5) Information transfer using single-cell signalling channel (SCCH)
6) Information transfer by the slow appended control channel (SACCH)
7) Information transfer by the fast appended control channel (FACCH)
8) Information transfer on the user packet channel (UPCH)

The Layer 1 unit sizes differ according to the type and direction of the information to be conveyed. Having regard to the direction "up" as designating transmission from the mobile station M to the base station B and "down" the reverse, the following basic sizes apply:

SCCH up first = 13 octets
SCCH up = 16
SCCH down = 17
FACCH = 11
SACCH up = 8
SACCH down = 12

These sizes at Layer 1 include a one octet Layer 1 header. Accordingly, at Layer 2 the sizes are one octet less. Each Layer 2 frame has a header which occupies the first unit of the frame. The first unit may include message information and the remainder of the information is included in a number of information units which follow. There is an error recovery system which detects corrupted transmission of a normal information frame I and on doing so ensures retransmission of the frame. However, in this system the maximum length of a frame is over 200 bytes. Retransmitting the whole frame in the event of an error is time consuming so it is proposed to detect corrupted units of the frame and request partial retransmission with a partial reject frame REJ'. This frame specifies those units to be retransmitted. Then a retransmission frame I' is sent from sender to receiver containing only those frames of information which have been requested.

The header for each frame contains an address field and a control field. The address/control field space is normally less than one Layer 1 unit so that the first unit of a frame is known to contain the header. Layer 1 has an automatic procedure whereby if the header (namely the first unit) of a frame is corrupted the whole frame is discarded. The consequent absence of an acknowledgement triggers

retransmission of the frame.

In this system the length of I and I' headers are:

I: address field = 1-5 octets
control field = 2
I': address field = 1-5
control field = 2+k, where k is the amount of non-received L1 units
L1 header = 1

Under these circumstances it is possible for the maximum length of the I' or REJ' header to be longer than one Layer 1 unit. The problem arises of how to deal with such long headers. The solution proposed is to use successive extension units to convey the extended control field and to use dummy octets to pad the length of the last I' or REJ' header unit to a standard unit size.

An example of a partial retransmission in accordance with the invention is shown in Figures 2 and 3. Figure 2 shows the flow of information from a base station B to a mobile M under FACCH, where the Layer 1 header unit size is 11 octets. In the first instance an original frame I is sent which has one header unit and seven information units, being eight units in all, numbered 0-7. This frame has a transmission sequence number of N(S)=i and a reception sequence number of N(R)=j. It is assumed that the address field is five octets and the control field is two octets. Now, suppose that on the first transmission the header unit is received but information units 1 to 5 are corrupted. The mobile issues a partial reject frame REJ' which includes the

reception sequence number N(R)=i and also a list of the units to resend, namely n(R)=1,2,3,4,5. It is to be noted that because of the length of the n(R) list the total length of the header required for REJ' is now 5+2+5=12. This is two more than the header allocation for FACCH. Accordingly, the final octet of the header is placed in the second unit of REJ' and the unit is padded with eight dummy octets to the standard length of 11 octets.

Next, the base station responds to the REJ' frame by sending a partial retransmission frame I'. This has the parameters N(S)=i; N(R)=j; n(S)=1,2,3,4,5. Again, the header will be conveyed in two units, the second of which is padded by eight dummy octets.

Now suppose that all but the seventh unit (namely No. 6) in the I' frame were received correctly. A further reject frame REJ' is sent from the mobile having a header of length 5+2+1=8. This is accommodated in one unit which again is padded to the full length of 11 octets with 2 dummy octets. The parameters of the frame are N(R)=i; n(R)=5. The base unit responds with a retransmission I' frame having a single unit header and the one required unit of information. The parameters for this are N(S)=i; N(R)=j; n(S)=5.

Figure 3 shows schematically the format for the original I frame and the successive I' frames.

Layer 1 has an automatic procedure for requiring retransmission of the whole frame if the first unit is corrupted. This is because the frame cannot be processed without the address and control fields. However, if the first unit is received but there is an extension unit for the control frame as in the first I' frame of Figure 3 which is corrupted then Layer 1

will be satisfied whereas retransmission is required. Accordingly, a feature of the invention is that Layer 2 acts to inhibit an acknowledgement in this event, and thus cause retransmission of the whole frame.

Figure 4 shows the 2 octet control field formats for numbered information transfer (I format) and supervisory functions (S format). In each octet following the first control field octet one bit is designated EC for control field extension. If this bit is set to 1 then it is known that this is the last octet of the control field. In accordance with a feature of the invention this EC indicator is used by Layer 2 to inhibit an acknowledgement if an extended control unit has been corrupted.

CLAIMS:

1. A digital mobile telephone control system comprising a LAPDM Layer 2 which interfaces with a TDMA Layer 1 wherein Layer 2 defines a frame structure for information, each frame consisting of a frame header having address/control fields and Layer 1 defines a structure whereby frames are disassembled to a unit structure for transmission and subsequently reassembled, the system including a facility for partial retransmission of original frames whereby some frames are partial rejection REJ' frames and some are partial retransmission I' frames, the control fields of the REJ' and I' frames including lists which identify units of the original frame which are for retransmission, the system being such that the frame headers for REJ' and I' frames may comprise one or more extension units and the or the final extension unit is padded to preserve the predetermined Layer 1 unit length.

2. A digital mobile telephone control system as claimed in Claim 1 wherein Layer 1 includes a facility for total rejection of a frame when an error is detected in the first header unit and Layer 2 includes a facility for total rejection of a frame when an error is detected in a header extension unit.

3. A digital mobile telephone control system as claimed in Claim 2 wherein the digital format for a control field includes a control field extension bit EC which is set to designate the final part of the control field and the Layer 2 total rejection facility

uses the EC bit setting to recognise header extension units.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

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(ii) Int CL (Edition 5) H04L 1/08, 1/12, 1/16, 1/18
H04Q 7/04

Search Examiner
G N CHAPMAN

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search
30 JUNE 1992

Documents considered relevant following a search in respect of claims 1 TO 3

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

me - doc99\fil000044

SF2(p)

Category	Identity of document and relevant passages	Relevant to claim(s)

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&: Member of the same patent family, corresponding document.

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